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Addressing the time-scale gap in erosion modelling - comparison of an event-based and a landscape evolution model

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An obvious timescale gap exists between a single storm event and long term landscape development. In this study the event- and physically based OpenLISEM soil erosion model was compared to the landscape evolution model LAPSUS, deliberately extending and shortening the timescales for which each model was developed. Calibration of OpenLISEM using average erosion rates derived from long-term simulations with LAPSUS and, vice versa, calibration of LAPSUS on event-scale did not give satisfactory results, suggesting that the gap between the different timescales of both models is too large to be bridged directly. However, calibration of LAPSUS on annual basis using the summed OpenLISEM erosion and deposition values for each year resulted in a good reproduction of these values by LAPSUS. Thus, when keeping to the timescale that the model was originally intended for, but calibrating the model using simulation results from the event-based model, short-term variability could successfully be introduced in longer-term modelling of landscape development. Subsequently, the erosion effects of rainfall variability, climate and land use change were explored on a centennial timescale. Results show non-linear behaviour between rainfall input and simulated net erosion. Simulated net erosion for increased rainfall erosivity was compared to rainfall variability, showing that mean annual net erosion of up to 15% increased erosivity is not significantly different from annual mean net erosion of the original simulations. Single events must be very high and/or frequent to leave a signal in the landscape that is beyond the scope of natural rainfall variability. Scenarios of human impact show that land use changes can have a potentially larger effect on erosion dynamics than climate variability and change. This is the first time that an event-based erosion model and a landscape evolution model were calibrated for the same area and compared in terms of erosion and deposition dynamics.